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AN ENQUIRY
INTO THE RESULTS OF
PUNCTURE OF THE HEAD,
IN CASES OF
CHRONIC INTERNAL HYDROCEPHALUS.

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ON THE
RESULTS OF PUNCTURE IN HYDROCEPHALUS.

SOME months since a case of chronic hydrocephalus came under the writer's observation, in the management of which a question arose as to the propriety of performing paracentesis capitatis. The operation was performed, but was not followed by any amelioration in the condition of the child, which died seventeen days afterwards.

While engaged in watching this patient, the writer referred to various sources, in order to ascertain what prospect of recovery is afforded by the operation. He met with reports of many isolated cases, and with opinions very positively expressed both in favour of paracentesis, as well as against its performance; but no work presented the results of actual experience. The following paper is intended to supply, in some slight degree, this deficiency, and to spare others the irksome task of hunting through the volumes of journals, in which most of these cases are recorded.

The history of the operation does not require more than a passing notice. In Hecker's dissertation* will be found full details of all that has been said concerning it by the writers of antiquity. Hippocrates was well acquainted with it, and it appears to have been occasionally practised, by surgeons in the middle ages, since, though it is now condemned by some as useless and dangerous, it is nowhere alluded to as a novelty, or spoken of as having fallen into disuse. Until the middle of the last century it was customary to allow as much fluid as could be evacuated to flow through the puncture. Le Cat, however, modified the operation by permitting the escape of only a small quantity of fluid at one time; and for the more convenient attainment of this object, he devised a peculiar trocar, of which a drawing and description are given in Vol. 47 of the Philosophical Transactions. Since then the operation

has been frequently resorted to, although the weight of authority was against its performance, until the recent announcement of Dr. Conquest that he had had recourse to it in 19 cases, in 10 of which he had obtained favourable results.

The writer has found mention of 63 cases of chronic hydrocephalus in which the cranium was punctured.* In two of these cases, however, the puncture was accidental,† while in five instances the results were not such as would justify classing the cases either as fortunate or unsuccessful.† Fifty-six cases then remain, in 40 of which the patients died, while in 16 they are alleged to have recovered; or, in other words, the proportion of recoveries to deaths was as 1 : 2.5, and as 1 : 3.5 of the total cases. These results, though considerably less favourable than those obtained by Dr. Conquest, still appear at first sight to afford ample justification of the operation: but the particulars contained in the following table will, perhaps, in some degree modify such an opinion.

* Two cases in which the fluid was accumulated between the scalp and cranium, constituting external hydrocephalus, are purposely omitted. They are described by G. C. Fenoglio, in *Omodei, Annali Universali*, vol. xxviii. p. 372; and by K. Textor, in *Meissner's Forschungen*: vol. iii. p. 242.

† These are the cases of Greatwood, (*Lancet*, May 23, 1829, p. 238), in which the puncture was made by a nail; and Höfling, *Casper's Wochenschrift*, Oct. 14, 1837, in which a hydrocephalic head was burst by a kick from a cow. The patient in both instances recovered.

‡ Holbrook, *London Medical Repository*, vol. xxiv. p. 345. Head punctured thrice, with slight amendment: final result not stated.

Dr. Vose, *Med. Chir. Transactions*, vol. ix. p. 354. Improvement from the operation, but disease returned, and destroyed the patient.

Dr. Conquest, *Lancet*, March 17, 1838, p. 890. Case of W. Honey: died of pertussis some months afterwards: placed by Dr. C. among his unsuccessful cases.

Dr. C. A. Lee, quoted in *Stewart on Diseases of Children*, p. 353. Punctured twice with benefit. Child died of cholera twenty days after second operation.

Dr. Kilgour, *Edin. Med. and Surg. Journal*, vol. lxxi. p. 363. Head punctured four times, operation then discontinued; no benefit seeming to accrue from it.

No	Sex.	Age.	Duration of Disease.	Symptoms before Puncture.	Size of the Head.	Number and Date of Punctures.	Quantity of Fluid in lbs. and ounces.
1	—	b'tween 11 & 12 years	—	Came on in consequence of a fall ; head enlarged to a third beyond natural size, and parietal bones opened so as to allow fluctuation to be felt. These symptoms came on three months after the fall.	A third larger than natural.	One	lbvj. of water drained away in 20 days.
2	F.	4 m.	began in 11 days 6th week	Began with fits and enlargement of head. Bowels torpid ; strabismus ; child had an idiotic look.	Apparently double the natural size.	Eighteen Dec. 10. 17. 25. 28. 31. Jan. 5. 9. 14. 19. 23. 28. Feb. 4. 8. 18. 25. Mar. 3. 6. 10.	oz. $\frac{1}{8} + 5 + 4 + 5\frac{1}{2} + 4 + 4 + 7 + 7\frac{1}{2} + 7 + 2\frac{6}{8} + 10 + 3\frac{1}{2} + 0 + 0 + 5 + 3 + 4 + 4 = 76\frac{1}{4}$.
3	F.	12 wks.	began a few days after birth	General health good, but bowels irregular ; strabismus, and rolling of the eyes.	23 inches incircumference.	Four August. 25. Sept. 4. 15. Oct. 5.	oz. $3 + 5\frac{1}{2} + 1 + 9\frac{1}{2} = 19.$
4	M.	4 mths.	head large at birth	Child healthy, cheerful, not emaciated. The fluid was supposed to be external to the ventricles.	18 $\frac{1}{2}$ inches in circumference.	Eleven Jan. 8. 15. 23. Feb. 19. Mar. 15. 19. Apr. 19. 27. May 5. 17. June 23	oz. $1\frac{1}{2} + 2 + 2 + 2\frac{1}{4} + 1\frac{1}{2} + 2\frac{1}{4} + 1\frac{1}{2} + 1\frac{1}{2} + 2\frac{1}{4} + 2\frac{1}{2} + 2 = 21\frac{1}{4}$.
5	—	14 m.	—	—	—	Nine within 4 months.	Ojss. by first puncture, less by subsequent ones.
6	—	10 m.	excited from birth	Child very ill ; pupils dilated. States that inflammation of the brain and its membranes existed, but does not mention a single symptom.	—	One	oz. 24.
7	F.	20 m.	began in 14th mth	Head had been gradually enlarging for half a year.	—	One	oz. 2, but a large quantity, supposed to be Oij. drained away.
8	M.	5 mths.	congenital	Hiccough and vomiting ; eyes heavy, somewhat convulsed.	Head of enormous size from birth.	Two begining of Aug. Sept. 3.	oz. $12 + 12. = 24.$
9	F.	—	—	—	—	Five	oz. 55.
10	F.	—	—	—	—	Three	oz. 26.
11	F.	—	—	—	—	One	oz. 13.
12	F.	—	—	—	—	One	oz. 9.
13	M.	—	—	—	—	One	oz. 6.
14	F.	—	—	—	—	Three	oz. $31\frac{1}{2}.$
15	M.	—	—	—	—	Two	oz. 14.
16	M.	—	—	—	—	One	oz. 9.

Subsequent Progress.	Date of Report.	Authority.
" Patient was saved."	—	Monro on Hydrocephalus, p. 146, quotes the case from Pr. Rossi.
The fluid removed was clear first, but, on the 8th and 9th punctures, was of a darker colour and thicker consistence, but regained its transparency at subsequent operations. The immediate effects of the puncture were never serious. Slight febrile symptoms, and occasional vomiting, and fretfulness, occurred at different periods, but fits only once, just before the sixth operation. The ossification of the head proceeded so that the situation of the first puncture became ossified.	Ninety days after first puncture; day of last puncture. Case then going on favourably.	Mr. Lizars, Ed. Med. and Surg. Journal, vol. xvii. p. 243.
The fluid was serous, on the second time was turbid and mixed with flakes of lymph. Slight fever after first, not after others. Ossification advanced; head diminished; child went on well; obscure fluctuation remained three weeks after last puncture. Calomel was then given, so as to affect the mouth.	Four months after last puncture, then stout, healthy, and very large of her age. Head ossified, except anterior fontanelle, and four inches less in circumference.	Mr. Russell, Ed. Med. and Surg. Journal, vol. xxxviii. p. 43.
After each operation there was great faintness, pallor, and failing of the heart's action during several hours. Great restlessness followed for a night or two after each operation.	Seventeen months after last puncture, child was healthy, and head measured $18\frac{3}{4}$ inches in circumference.	Graefe. Graefe and Walther's Journal, Bd. xv. S. 348.
Great improvement followed the first puncture; the others left the child in a very satisfactory state.	Died of pneumonia more than a year afterwards.	Dr. Fourcade, Lancette Francaise, vol. iv. No. 47, p. 188, reports from recollection case operated on by Dr. Bédor.
Iodide of potassium ointment employed; calomel and mild aperients given. " Though the little sufferer was for some time in a precarious state, he did recover, and is now a very fine boy, never having had the slightest return of the complaint."	—	Mr. Marsh, MED. GAZ. vol. xvii. p. 985.
One convulsion followed the puncture, and afterwards other symptoms of meningeal irritation.	Two and a half years afterwards health and intellect good.	
Continued weakly during the day of puncture, but more lively than before, and for some time after the intensity of all the former symptoms diminished. A month after it was found necessary to repeat the puncture.	Nearly eight years after, head then too large, but not larger than before the operation. Health good.	Dr. Conquest, Lancet, March 17, 1838; and MED. GAZ. vol. xxi. p. 967.
— — — — — —	Five years after, head 22 inches round; ossification complete, except posterior fontanelle, and two openings in coronal suture. Health good, remarkably shrewd.	

Chronic hydrocephalus is a disease usually slow in its progress and intermittent in its advances, occasionally pausing for months, or even years, and then increasing without any evident cause. Before any case, then, can be admitted to have been cured by the operation, it must be shown that a considerable time had elapsed since its performance; and that during this period the health of the patient was perfectly good. Nos. 4, 7, 8, and 9, are the only instances in which both these conditions are fulfilled. In No. 5, the former condition is complied with, but the evidence of the patient's health is very unsatisfactory; the case being reported some years after the death of Dr. Bédor, while nothing can be more vague than the statement that the child was left *dans un état très satisfaisant*. The history of Mr. Russell's patient is com-

plete; but with the evidence afforded in Dr. Vose's case, in which the disease returned and proved fatal after apparent recovery, we should be slow to admit four months as a period sufficiently long to test the permanence of the cure. In the child operated on by Mr. Lizars, decided improvement seems to have followed the puncture; but his report of the case was forwarded on the very day on which he performed paracentesis for the eighteenth time, and of the subsequent history of the patient nothing is recorded. But, defective as the cases are in the above-mentioned respects, they are not less so in the absence of information as to the condition of the child before the puncture was resorted to. Cases 2, 3, and 4, are the only ones in which this condition is at all satisfactorily fulfilled. Very imperfect notices exist of Nos. 1, 6, 7, and 8; leav-

TABULAR VIEW OF CASES OF INTERNAL HYDROCEPHALUS IN

No.	Sex.	Age.	Duration of Disease.	Symptoms before Puncture.	Size of the Head.	No. of Punctures.	Quantity of Fluid.	Immediate Effect.
1	M.	9 m.	Began at 3d month.	Sucked well, but was emaciated.	At 8th month larger than head of a man.	One	1lb. Fluid continued to drain away afterwards.	—
2	M.	3 m.	Began in 7th week.	Well nourished, but fretful.	Sutures separated.	Three	$5 + 5 + 5 = 15$	—
3	—	3 m.	—	—	Very large.	One	—	Bore operation well.
4	—	2 m.	Con-genital.	Healthy and strong: head had much increased in size; eyes very prominent.	—	Five	$10 + 12 + 14 + 12 + 32 = 80$	—
5	M.	2 y.	Con-genital.	Well.	25 inches round at 6th month	One	—	—
6	F.	5 m.	Noticed at 5th month	Indisposed for three weeks with crying and screaming. Pupils immovable.	Very large, fluctuating.	Six	$9\frac{1}{2} + 9\frac{1}{2} + 6 + \frac{1}{4} + 2\frac{1}{2} + 1\frac{1}{2} = 29\frac{1}{4}$	Sickness and vomiting after 2d; 4th puncture made in the fontanelle; $4\frac{1}{2}$ oz. of blood escaped, and child seemed like to die.

ing 9 out of 16 cases in which this point is passed over in silence.

It would have been interesting to have been made acquainted with the circumstances to which the brilliant success of the operation in Dr. Conquest's hands is attributable. But, unfortunately, no data are given in 15 out of 19 cases, beyond the mere statement of the number of punctures, and the quantity of fluid removed. The age of the patient, the duration of the disease, the symptoms attending it, the size of the head, and the condition of the intellectual faculties before and after the operation, are not noticed. We are left in perfect ignorance as to the time which elapsed before each patient was reported as cured ; and yet, on grounds so slender, an impression has got abroad in this country and elsewhere

that paracentesis capitis is a means to which recourse may be had in cases of chronic hydrocephalus, with a well-founded expectation of success.

From numbers so small, and furnished with such imperfect details, it would be impossible to attempt any numerical exposition of the chances of recovery afforded by the operation. An analysis of the first table has shown how few are the instances in which permanent cure has been proved to have resulted from its performance. The second table not merely exhibits the great preponderance of failures over successful cases, but likewise shows that in very many instances an aggravation of the symptoms followed the operation, and that life was apparently much shortened by it.

WHICH PARACENTESIS WAS UNSUCCESSFULLY PERFORMED.

Subsequent Progress.	Date of Death.	Condition of the Brain after Death.	Authorities.
Child sank.	36 hours after the puncture.	—	Fabricius Hildanus, <i>Ob- serv. Chirurg. cent. iii. obs. 17.</i>
Well for 2 days, then taken ill : died on evening of 4th day.	84 hours after 1st, 36 after last puncture.	Excessive dilatation of ventricles ; atrophy of pineal gland ; very little trace of choroid plexuses.	Le Cat, <i>Philos. Trans. v. xlvi. p. 257.</i>
—	Day after the puncture.	Fluid between cranium and dura mater.	La Motte, <i>Traité complet de Chirurgie, tome i. obs. 115.</i>
After 3d puncture, head reduced to natural size ; after 1st week, head swelled again. Exhaustion came on 3 weeks after 5th puncture ; death in 10 days.	3 months 9 days after 1st, 31 days after last puncture.	Cavity of brain full of enormous quantity of clear water ; scarcely any brain found, but only medulla oblongata, and a small quantity of brain behind the orbits.	Dr. Remmett, <i>Edin. Med. Comment. vol. vi. part 4.</i>
—	16 hours after puncture.	Two pounds of clear fluid contained in brain, in cysts, with vascular coats ; cerebellum around fourth ventricle hard ; crura cerebri ulcerated.	Dr. A. Monro, <i>Morbid Anatomy of the Brain, vol. i. p. 11.</i>
More lively ; convulsions ; and hemiplegia affecting right side, on 3d day after 1st puncture ; ceasing in course of one day. Diarrhoea for some days. Coma before 2d and 3d punctures ; relieved by the operation. Seemed better on day of 6th puncture ; fits on following day ; tranquil death soon after.	37 days after 1st, 1 day after last puncture.	Two pounds of sero-sanguineous fluid in ventricles ; walls of ventricles very thin ; brain soft ; coagulum size of a hazel-nut in posterior corner of left lateral ventricle.	Mr. R. Brown, <i>Med. and Phys. Journal, vol. li. p. 102.</i>

No	Sex.	Age.	Duration of Disease.	Symptoms before Puncture.	Size of the Head.	No. of Punctures.	Quantity of Fluid.	Immediate Effect.
7	M.	9m 20d	Con-genital.	Good, and continued so, notwithstanding fruitless employment of medicines ; head hot, appetite craving.	23 inches round above tips of ears.	Ten	$4\frac{1}{8} + \frac{1}{4} + 5 + 3 + 3\frac{1}{2} + 3 + 3\frac{5}{8} = 40$	No striking effect.
8	M.	9 m.	Con-genital.	Child had a spina bi-fida, but health good.	27 inches round.	Three	$10 + 16 + 14 = 40$	—
9	F.	4 m.	Con-genital.	General health good ; head had progressively enlarged.	24 inches round.	Eight	$12 + 12 + 12 + 9 + 12 + 3 + 9 + 12 = 81$	Very slight except after 5th puncture, when faintness was produced.
10	—	6 m.	Six or seven weeks after birth	Always unquiet, but tolerable health to 5th week ; became gradually emaciated ; bowels irregular ; constant crying, no sleep.	23 inches round.	One, but wound opened twice a day for several days.	116 in course of 8 days.	—
11	M.	7 m.	Began about a month after birth	Fever ; screaming ; squinting at 3d week ; in 10 days enlargement of head, which increased ; other symptoms abated.	21 $\frac{1}{2}$ inches round.	One	6	Vomiting soon after.
12	M.	8 m.	Began in 3d month.	Sickly from birth ; convulsions at 2 months ; emaciation ; constant crying ; strabismus.	21 $\frac{1}{2}$ inches round.	Five	$14\frac{1}{2} + 3\frac{1}{4} + 7 + 7 + 16 = 47\frac{6}{8}$	Uneasy during 1st, sensible of pain afterwards ; uneasy, and occasionally convulsed after 5th.
13	M.	11 w.	Began in 6th week.	Always fretful, throve till 6th week, then wasted ; head swollen. No squinting.	Fluctuation in head distinct.	Six	6 by first, afterwards + 36 = 42	No inconvenience ; sensible improvement.
14	M.	5 m.	Began at 2 months.	Good for two months, but head always inclined to side ; then swelling of head, fits of crying, cough, and emaciation. No vomiting or convulsions	20 $\frac{1}{2}$ inches in circumference.	One	11	None ; head much collapsed ; vomited same evening.
15	—	5 w.	—	—	Supposed to contain 2 to 3 pints.	Five	$4 + 3 + 4 + 4 + 4 = 19$	—
16	—	6 $\frac{1}{2}$ m.	Began in 4th month	Well nourished : general symptoms very slight.	—	One	37	Brain protruded through 1st puncture (with a lancet), which was therefore repeated.

Subsequent Progress.	Date of Death.	Condition of the Brain after Death.	Authorities.
Slight improvement followed each puncture. Continued well, except erysipelas of face, till day of last puncture; then, convulsions returning frequently, child wasting till death.	84 days after 1st, 11 after last puncture.	Dura mater thickened; pia mater inflamed; cerebral substance very thin, lined by false membrane; no trace of corpus striatum, callosum, &c.; bag of cerebrum divided into cells by membranous bands, contained 35 oz. of fluid; cerebellum firm.	Mr. Money, Med. and Phys. Journal, vol. lii. p. 462.
—	30 days after 1st puncture, 9 after last.	—	Mr. Gray, Med. and Phys. Jo., vol. liv. p. 204.
Health good for a few days: considerable exhaustion after 2d puncture. On 5th puncture, 6 weeks after 1st, situation of original puncture ossified. Two convulsions before 7th puncture, again after 8th. Seemed going on well, though fluid re-collected; head greatly diminished in size; sutures, which had been 3 inches across, came into apposition. On 9th day, convulsions, coma, death.	110 days after 1st, 8 after last puncture.	Fluid between dura and pia mater; the former thickened, but with no signs of acute inflammation; brain nearly all absorbed, not larger than a hen's egg, soft, and parts not distinguishable.	Dr. Glover, Philadelphia Jour. of Med. and Phys. Sciences, vol. ii. p. 159.
Seemed going on well, though fluid re-collected; head greatly diminished in size; sutures, which had been 3 inches across, came into apposition. On 9th day, convulsions, coma, death.	9th day from making the puncture.	Membranes gangrenous for several inches round puncture, contained four pounds of turbid, foetid fluid; whole upper part of brain disappeared; some at base, like pons varolii.	Dr. Witmore, American Med. Recorder, July 1821.
First night restless; next night better; screaming 58 hours after, followed by fits; and death, in fit, 14 hours after.	72 hours after puncture.	No trace of inflammation; brain very soft; two transparent sacs in left ventricle, one in right communicating with third and fourth: they were smooth and tough, attached to brain at under, unconnected at upper surface; nates and testes formed a tumor, containing 1 drachm of pus; lower parts of brain healthy.	Mr. Hood, Ed. Med. Surg. Journal, vol. xvii. p. 510, Oct. 1821.
Slight convulsions on night after 1st puncture; improvement, less strabismus, increased ossification; cried much after 4th convulsions, and death 3 days after 5th. Relief after each puncture; a fortnight after last, water ceased to accumulate. No ossification of skull took place.	51 days after 1st puncture, 3 after last.	No sign of inflammation; fluid in ventricles; brain greatly expanded; cerebellum healthy.	Dr. Freckleton Ed. Med. Sur. Journal, vol. xvii. p. 240.
Went on well till 3d day, head being $2\frac{1}{2}$ inches smaller. On 3d day, great restlessness, vomiting, rigidity of one arm, convulsions: death on 4th day.	11 weeks after 1st puncture, 3 after last.	No sign of recent inflammation; $2\frac{1}{2}$ lbs. of fluid in sac of arachnoid; atrophy of cerebrum which was not larger than a bean.	Mr. J. Sym, Ed. Med. Sur. Journal, vol. xxiv. p. 295.
—	87 hours after the puncture.	No inflammation of brain or its membranes; ventricles contained yellowish white fluid, like seropurulent fluid and water, with albuminous flakes; some softening of ventricles.	Dr. J. Alison, Ed. Med. Sur. Journal, vol. xlili. p. 359.
Pretty well, but somewhat excited 1st day; head filled again between 3d and 6th day; on 7th, a gush of fluid from situation of 1st puncture, followed by convulsions and involuntary discharge of urine and faeces.	16 weeks after 1st, 5 weeks after last operation.	—	Mr. Callaway, as reported by Oppenheim, Rust's Mag., v. xxiv. p. 77.
—	9th day after the puncture.	—	Dr. Roechling, Hufeland's Journal, Aug. 1826, p. 114.

No	Sex.	Age.	Duration of Disease.	Symptoms before Puncture.	Size of the Head.	No. of Punctures.	Quantity of Fluid.	Immediate Effect.
17	F.	16 m.	Began at end of 3d month.	Began with convulsions; health then good until dentition began, then lost motion of left arm and leg; had fits with each tooth, and occasional strabismus.	26 inches round.	One	2½, and more drained from wound.	Considerable collapse.
18	F.	16 m.	Began in 4th month	Health bad; pupils dilated; insensible to light; coma for several months; occasional convulsions.	—	One	20	Cold, faint, lips livid, requiring strong stimulants.
19	F.	6m. 3w	Began at 5th month	Great strabismus.	18 inches in circumference.	Four	$9 + 2 + 3 + 2\frac{1}{2} = 16\frac{1}{2}$	No suffering.
20	—	15 w.	—	—	—	One	10	—
21	—	9 m.	—	Great emaciation.	30 inches in circumference.	One	10	—
22	—	2 m.	Congenital.	Health tolerably good — child intelligent.	23 inches in circumference.	Two	28	Improved appearance.
23	M.	4 m.	Began at 1 month.	Good, except frequent convulsions.	21 inches in circumference.	Seven	$1\frac{1}{2} + 2 + 6 + 11 + 15 + 12\frac{1}{2} + 14 = 63$	None.
24	—	3 m.	Began at 1 month.	Health good, but bowels costive; had spasms when a week old, ceased after 3 weeks, when head suddenly enlarged.	—	Four	$14 + 17 + 14 + 13\frac{1}{2} = 58\frac{1}{2}$	Slight haemorrhage from a vessel at 3d puncture.
25	M.	7m 12d	Began at 2d month.	Small-pox at 5th week; enlargement of head from 2d month; at 5th month blind; oscillation of eyes; starting and screaming, afterwards fits.	22½ inches round at 5th month	Ten	$4 + 5 + 6 + 7 + 12 + 16 + 12 + 28 + 42 + 20 = 153$	After 3 of the punctures, faint and pale, and once vomited. Nothing after any of the others.

Subsequent Progress.	Date of Death.	Condition of the Brain after Death.	Authorities.
A little improved 1st night, pretty well till 3d day; then violent convulsions and death.	4th day after the puncture.	Brain bloodless; 2 lbs. of fluid in ventricles; great thinning of their walls, of right especially, which formed a mere membranous bag, and was in parts of consistence of cream; parts at floor of left ventricle barely recognizable; at floor of right undistinguishable; cerebellum and base of brain healthy.	Dr. S. Hall, MED. GAZ. vol. vi. p. 334.
Slight fever for a few days, then seemed better. In 10 days water began to accumulate. In 1 month and 3 days symptoms of nervous debility, in 3 days more painless death.	5 weeks after the puncture.	No trace of inflammation; great accumulation of fluid in the ventricles.	Mr. Marsden, Lancet, Feb. 12, 1831, p. 648.
Vomiting on 2d and 3d day, fever on 4th, coma on 5th, convulsions on 6th.	6 days after puncture.	One pound of fluid in cranium; puncture had not penetrated the brain; dura mater adherent to skull; brain soft and very vascular; great distension of lateral ventricles with fluid; no inflammation about puncture.	Oppenheim, Rust's Mag. v. xxiv. p. 89.
—	—	All the ventricles formed but one large cavity, covered by but very little brain.	Ruppius, in Meissner's Forschungen, vol. iii. p. 240.
—	In a few days after the puncture.	—	Meissner, Die Kinderkrank- heiten, vol. ii. p. 187.
Exaltation of sense of hearing, then improvement for 2 or 3 days; re-accumulation of fluid in a fortnight, gradual sinking after 2d puncture.	3 weeks after 1st puncture, 1 week after last.	Great vascularity of the membranes; softening of the brain; accumulation of fluid in the ventricles.	Mr. F. Cooper, Lancet, June 27, 1835, p. 405.
Convulsions ceased a few hours after 1st puncture; returned slightly before 3d and 5th. Health good till day before last puncture, then stupor; relieved for a time by puncture; 2 days after, quiet death.	115 days after 1st, 2 afterlast puncture.	Membranes pale, bloodless; septum lucidum torn; lateral ventricles formed one large sac, lined by thick flakes of matter, like pus or mucus.	Prof. L. A. Dugas, Amer. Journ. of Med. Sciences, vol. xx. p. 536.
Convulsions on 5th day; continued enlargement of head after each puncture; occasional convulsions, followed at length by coma and death.	62 days after 1st, 11 after last operation.	Fluid in the ventricles; great thinning of the brain; hole through falx and tentorium; cerebellum healthy.	Dr. J. B. Withridge, Am. Journ. of Med. Sciences, vol. xx. p. 538.
Improvement for 2 months, and progressing ossification; then improvement ceased, and head became quite as large as ever.	131 days after 1st puncture, 2 days after last.	Arachnoid engorged; fluid in all three ventricles; brain very soft; lymph at its base.	Dr. J. R. Smyth, MED. GAZ. vol. xxv. p. 83.
Convulsions came on, but ceased some weeks, till day before death, and child died in a fit.			

No.	Sex.	Age.	Duration of Disease	Symptoms before Puncture.	Size of the Head.	No. of Punctures.	Quantity of Fluid.	Immediate Effect.
26	F.	10 d.	Congenital.	Good at birth ; at end of ten days head hot; child fretful; bowels disordered.	Head at birth twice natural size.	Two	$10 + 8 = 18$	After 1st puncture cold, faint, as though about to die; state after 2d not mentioned.
27	M.	8 m.	Began at end of 4th month	Health quite good up to 10th week, even now tolerably good; bowels regular; well nourished; eyes constantly rolling.	$22\frac{1}{2}$ inches in circumference.	Four	$20 + 23 + 22 + 19 = 84$	No peculiar effect.
28	F.	9 m.	Began in 3d month.	Healthy ; in 15th week able to hold up its head, though very large ; cried occasionally ; continued well to 9th month, but head then too big to move.	$21\frac{1}{2}$ inches in circumference.	One	4, much drained away.	$\frac{1}{2}$ oz. of blood escaped ; 4 days after, on passing a probe, 4 oz. of water.
29	—	8 m.	Began at 4th month	Screamed very often ; slight convulsions ; occasional vomiting ; distortion of eyes downwards.	—	Two	$4 + 3 = 7$	Improved appearance followed immediately.
30	—	7 m.	Began at 2d month.	Good health.	$19\frac{1}{6}$ inches in circumference.	Two	$20 + 28\frac{1}{2} = 48\frac{1}{2}$	Pale, cried slightly after 1st ; pale, did not cry after second.
31	F.	12 w. 1 d.	Began in 3rd week	Fits of crying a fortnight after birth continued to recur, but without convulsions or strabismus.	$16\frac{1}{2}$ inches in circumference.	Five	$12 + 12 + 5 + 8 + 16 = 53$	Crying ceased ; child seemed more comfortable.
32	M.	—	—	—	—	Five	$48\frac{1}{2}$	—
33	M.	—	—	—	—	Four	45	—
34	M.	—	—	—	—	Two	20	—
35	M.	—	—	—	—	One	8	—
36	M.	—	—	—	—	Two	22	—
37	M.	—	—	—	—	Two	17	—
38	F.	—	—	—	—	One	$7\frac{1}{2}$	—
39	F.	—	—	—	—	Four	33	—
40	M.	15 m.	Began at 5th month	Inward fits from birth; emaciation at a fortnight ; increase of head and fits at 5 mo. ; general health improved until 14 months, then fits more frequent, and child wasted more ; but appetite very good.	26 inches in circumference.	One	16	Cried much ; slight fit immediately after.

Subsequent Progress.	Date of Death.	Condition of the Brain after Death.	Authorities.
After 1st puncture, seemed improved; water re-accumulated at end of a week; after 2d, no improvement; at end of a fortnight after, head as large as before. Parents would not permit its repetition. Child wasted; died convulsed.	6 months 5 days after 1st, 5 months 12 days after last operation.	Fluid under dura mater; cerebrum so flattened that parts were undistinguishable.	Mr. Armstrong MED. GAZ. v. xxvi. p. 226.
Occasional vomiting; slight convulsions; head rapidly regained its size. 14 days after last puncture, moaning, crying, contractions of limbs, faintness, and difficult breathing came on.	7 weeks 3 days after 1st, 15 days after last operation.	Fluid within the membranes; left hemisphere almost totally destroyed, right greatly compressed; optic nerves diseased; left olfactory destroyed; right nearly so; cerebellum healthy.	Dr. Kilgour, Ed. Med. Sur. Journal, vol. liii. p. 365.
On day after the escape of the fluid, slight convulsions, eyes less distorted, but child began to sink, whined, then threw its arms about.	6th day after puncture.	Some congestion of membranes near puncture; brain quite white, very soft; ventricles immensely distended; cerebral substance seemed macerated, infiltrated with water; parts in ventricles undistinguishable; nerves at base soft; cerebellum large, soft; cavity in its centre; no trace of arbor vitæ.	Dr. Schaeffer, Casper's Wochenschrift, Aug. 19, 1837.
On evening of 4th day after first tapping, child grew dull; respiration hurried, and death took place before midnight.	4th day after 1st, 3d after 2d puncture.	—	Dr. Watson in Tweedie's Lib. of Med. p. 147.
After 2d puncture, cerebral symptoms came on, head being smaller. Head regained size in 10 days after 1st puncture.	24 days after 1st, 24 after 2d puncture.	—	Malgaigne, l'Expérience, Nov. 19, 1840.
Occasional fits for 10 days after 2d puncture; then frequent screaming, and increasing weakness, without fits, till 2 days before death, when they returned frequently.	15 weeks after 1st puncture, 5 weeks after last	Twenty-nine ounces of clear fluid in ventricles, which were lined by a brownish mucus; septum lucidum thickened; small tubercle at decussation of optic nerves.	Dr. Coldstream, Edin. Monthly Jour. of Med. Sci. April, 1841.
—	—	—	Dr. Conquest, Lancet, March 17, 1838; and Med. Gaz. vol. xxi. p. 967.
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Daily fits for 4 days, with more sluggish condition than before. In 7 days, head as large as before the puncture, to the repetition of which parents would not consent; refused food; diarrhoea for 7 days; emaciation, increased weakness; death.	17 days after the puncture.	Seventy-five ounces of fluid in the ventricles, and infiltrated into brain, which was split up into layers forming several distinct pouches; the walls of these pouches were not formed by false membrane, but were all continuous with the corpus callosum, into which their fibres might be traced; cerebral substance at base had a jelly-like appearance; optic nerves much spread out; fluid infiltrated be-	The writer.

In 30 of the above 40 cases, the interval which elapsed between the performance of the operation and the patient's death is stated; and it appears that the deaths after the first puncture were as follows:—

Deaths.	Average duration of life after the puncture.
6 within 4 days	53 hours
6 , , 14 days	6 days, 8 hours
3 , , 1 month	20 days, 16 hours
9 , , 3 months	56 days, 10 hours.

Of the remaining 6, only 1 survived the puncture 6 months; and the average duration of life in each of these was 3 months, 4 days, 12 hours. In 18 of these patients, the operation was performed more than once; but in no instance did the children survive the last puncture more than 35 days, while the average duration of life was 12 days, 22 hours.

The instances, then, in which life was prolonged by the operation appear to be very few, and the cases in which any reasonable prospect of the patient's recovery existed after a week had elapsed from the first performance of the puncture, are still fewer. The table shows that sometimes the puncture was followed by an almost immediate aggravation of the cerebral symptoms, and by death. Usually, however, a degree of apparent improvement followed the puncture, but the fluid soon collected again, and less marked relief followed the second operation. With its repetition the quantity of fluid increased, and while the size of the head continued undiminished, or even grew larger, the body of the patient became emaciated; and death either took place

from exhaustion, or cerebral symptoms came on, and life was terminated by coma or convulsions. The termination of an ordinary case of chronic hydrocephalus is usually preluded by low fever, with general emaciation, to which fatal coma or convulsions succeed; and precisely similar are the symptoms noticed in the cases in the second table, except that the signs of cerebral disturbance appeared with an intensity which, but for the mechanical injury to the brain, they would, probably, not have presented.

If the symptoms observed during life yield little encouragement to resort to the operation, the appearances disclosed after death afford a powerful argument against it. An account is given of the post-mortem examination of 26 cases. In every instance fluid, sometimes in considerable quantity, was contained within the ventricles or in the cavity of the cranium, and the substance of the brain was softened and attenuated. But, in addition to these appearances, there existed, in 16 cases, serious organic disease or malformation of the brain itself, though no symptom during life had betrayed the existence of a condition which mechanical interference could only aggravate.

The above-mentioned facts have led the writer to form an opinion unfavourable to the performance of puncture of the head, as a means of curing chronic hydrocephalus. Other points of interest might be elicited by an examination of the tables, but it would not be possible to dwell on them within the limits of a single paper.